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Applicant (s)

(21) *Patentansökningsnummer* 0203780-2
Patent application number

(86) *Ingivningsdatum* 2002-12-19
Date of filing

Stockholm, 2004-03-10

För Patent- och registreringsverket
For the Patent- and Registration Office

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Avgift
Fee 170:-

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2002-12-12
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Distributed query of real world objects

TECHNICAL FIELD

The present invention is concerned with control systems where real world objects are represented as Aspect Objects. The method and the system according to the invention are particularly suitable for use at industrial plants of industries such as a chemical, pharmaceutical, food, metal, mines, building material, pulp and paper. Other industries and utilities where the invention is particular useful are automotive, consumer products, power generation, power distribution, waste water handling, oil refineries, pipe-lines and off-shore platforms.

BACKGROUND ART

WO00102953, hereby incorporated by reference, entitled "Method of integrating an application in a computerized system" describes a method to represent real world objects (referred to as real world entities in WO00102953) in a computerized system in a systematic way, in which different types of information about the real world object may be obtained, linked to the real world object, processed, displayed and acted on. In WO00102953 a real world object is represented by a certain kind of software object called a composite object. Each application integrated in the computerized system defines interfaces that are independent of the implementation of the application itself. These interfaces may be used by other applications, implementing other aspects or groups of aspects of a composite object (from here and forward in this description a composite object is referred to as

an Aspect Object), such that the applications can co-operate to provide a functionality for the representation of a real world object that is the sum of all aspects. A problem with the method disclosed in WO00102953 is that it does not disclose how to resolve access to an Aspect of an Aspect Object based on Internet technology.

US 6,170,007 describes how a web server in a device provides access to the user interface functions for the device through a device web page. A network interface in the device enables access to the web page by a web browser such that a user of the web browser accesses the user interface functions for the device through the web page. A remaining problem is how to get access from a web browser to different functions of a real world object represented as an Aspect Object, such as a CAD-drawing or maintenance record of the device, where the functionality resides in a number of un-related applications.

US 6,400,997 describes an apparatus and a method for factory automation and tracking with focus on a factory automation apparatus, which includes a plurality of portable tablets and an automation server in a wireless communication.

There are a number of enabling technologies, which enables remote access across a network. Examples of such technologies are RPC (Remote Procedure Calls), DCOM (Distributed COM) and CORBA (Common Object Request Broker Architecture). Another example of a technology enabling remote access to objects by use of Internet technologies is called Web Services.

WO 0077653A1 describes a method and apparatus for providing network services. The description relates how HTTP (Hypertext Transfer Protocol) may be used, including the HTTP methods GET and POST to provide input data for a web service. The description also includes such functions as one called a Web Service Provider and one called a Web Services Directory. The latter function provides information about which web services are available and where they may be found. A remaining problem is to enable access to an Aspect of an Aspect Object from a World Wide Web presentation means, which Aspect represents a function or facet of a real world object connected to an control system, such as a industrial control system.

SUMMARY OF THE INVENTION

The object of the present invention is to enable a web client application to access a function of a real world object represented as an Aspect Object in a Control System.

This object is achieved by a method to enable access to a function of a real world object represented as an Aspect Object in a Control System the method comprising calling a Control System from a web client application in a client device, downloading from the Control System a representation of the Aspect Object and Aspects associated with the Aspect Object, downloading from the Control System a representation of an Aspect Category and an Aspect Type and downloading a representation of an Aspect System Object to the client device wherein a function of the real world object is enabled for access. Compared to prior art this enables a user of the client device to easily access functions of large number of real

world objects represented as Aspect Objects from the client device which does not need to be pre-installed with software referring to Aspect Objects, Aspects, Aspect Types or Aspect System Objects of the Control System.

It should be appreciated that since the query for a reference to an interface of the Aspect System Object and an associated table look-up is performed in the client device, instead of in the Control System, the Control System is more efficiently used, which provides for increased reliable control of the real world objects.

Another object of the invention is to provide a computer program that causes a computer or processor to carry out one or more steps of the above described method.

Yet another object with the invention is to provide a computer readable medium having a program recorded thereon, where the program is capable to make a computer perform any of the steps in the above described method.

Another object of the invention is to provide a control system for access of a function of a real world object associated as an Aspect of an Aspect Object, the Control System comprising means for handling a call from a client device external to the Control System, means for downloading to the client device a first software component comprising a representation of the Aspect Object and an Aspect associated with the Aspect Object, means for downloading to the client device a second software component, which second software component comprises a representation of an Aspect Category and an

Aspect Type and means for downloading an Aspect System Object to the client device wherein a function of the real world object is enabled for access.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be described in more detail in connection with the enclosed schematic drawings.

Figure 1 shows an overview of a method according to prior art.

Figure 2 shows a more detailed overview of the table look-up of a method according to prior art.

Figure 3 shows an overview of a method according to the invention, a web server and a user of an Internet client application who intends to access a function of a real world object.

Figure 4 shows an example of two software components, which, according to the invention, are downloaded to the web client application.

Figure 5 shows schematically a system based on the invention, where the name-look up of an Aspect is performed in the same computer or computing client device as where the web client application is executing.

DETAILED DESCRIPTION OF THE INVENTION

In order to appreciate the invention it is beneficial to study some specific prior art. WO00102953 describes a method for integration of many and various types of applications in a computerized system, based on a concept where real world objects are represented as Composite Objects. Examples of a real world objects are a valve, a transmitter, an actuator or a sensor. An example of a more complex real world object is a mixing unit, a motor, a compressor, a reactor, a boiler, a conveyor, a switchgear or an industrial robot. Yet another example of a real world object is a product, a raw material or a production batch. A Composite Object is in this application referred to as an Aspect Object. Different functions or facets of a real world object, such as its physical location, the current stage in a process, a control function, an operator interaction, a simulation model, some documentation about the real world object are described as different Aspects of the Aspect Object. Each Aspect Object is a container for one or more Aspects. An Aspect Object is not an object in the traditional meaning of object-oriented systems, but rather a container of references to such traditional objects, which implement the different Aspects. Figure 1 shows a schematic overview of how according to prior art a client application 1 in a computerized system 10 gets access to a function associated with an Aspect of an Aspect Object 3 representing a real world object 11. The client application 1 queries an Aspect Object 3 for a reference to an interface that provides the function. The client application queries the Aspect Object 3 by invoking a method of a known interface 2 of the Aspect Object 3. A

typical name of such of a method of such an interface 2 is QueryAspectInterface. In the system according to prior art a reference to an interface of an Aspect System Object 8 is found by means of a Table look-up 4, the reference is returned to the client 9. An Aspect System Object 8 is for example a COM object that provides access to at least part of the functionality of an Aspect. According to prior art objects are for example identified with class identifiers (CLSID) and interfaces are for example identified with interface identifiers (IID). An Aspect System Object is initialized with a reference (i.e. a pointer) to an Aspect. The Aspect System Object 12 may contain several references of interfaces, which enables access to traditional objects and software applications.

Figure 2 shows the mechanism of the table look-up 4, according to prior art, in more detail. According to prior art the mechanism for finding a reference to an interface of an Aspect System Object 8 involves that a client application 1 queries an Aspect Object 3 for a reference to an interface. Figure 2 shows that the Aspect Object 3 examines its Aspects, including Aspect2 22 through the Aspect Category 23. An Aspect Category 23 identifies the Aspect Type 24, which describes a piece of a software application, which is integrated in the computerized system. Such a piece of a software application may for instance implement methods associated with functions of a real world object 11. Examples of such functions are open, close, start, move, mix or heat. Examples on more complex functions are "disconnect phase fault" or "adapt to second type of car body". Access to functions through interfaces of Aspect System Objects

according to prior art, involves instantiation of Aspect System Objects, Composite Objects, the Aspect Category, and the Aspect Type, implemented for example as COM objects. Such instantiations are made in clients and servers of an Aspect based computerized system 10, such as a Control System. A drawback with prior art is that it requires software, such as for example dll's (dynamic link libraries) to be preinstalled in the client devices hosting the client application 1.

Figure 3 shows an overview of a method according to the present invention. The method enables access to an Aspect of an Aspect Object from a web client application, such as a web browser, which executes in a client device, without requiring that the client device 32 is pre-installed with any software other than the web client application 31. A web client application is any software application that is intended for general use on an Intranet or Internet 30, hence a web browser is an example of a web client application. An instance of the Aspect Object 38 resides in a control system 10, which comprises at least one Aspect System 39. The Aspect Object 38 may have been instantiated in the Control System before the method is applied. The Control System 10 typically comprises a plurality of Aspect Systems. An Aspect System 39 makes it possible to create and associate Aspects to Aspect Objects 38 in the Control System 10. When a new function is added to the Control System 10 software is typically supplied as an Aspect System 39 to the Control System 10.

Figure 3 shows an overview of a method according to the invention. A web client application 32, which executes in

a client device 31, calls a control system 10 and requests for a representation of an Aspect Object. The Control System comprises at least one Aspect System 39. As an example on how a call can be initiated, a user 31b of the web client application may initiate the call. For instance a process operator may request to access a certain Aspect of an Aspect Object. The call is performed across Internet or an Intranet 30. The call may be divided into a plurality of messages. A first software component 34 is downloaded via Internet or the Intranet 30 to the client device 32. The first software component 34 comprises a representation of the Aspect Object 38 and at its Aspects 39. After the download of the first software component 34 to the client device 32, the Aspect Object 38 represented in the first software component is initialized by the web client application 31. One can also say that the web client application incarnates the Aspect Object 52. A second software component 36 is also downloaded to the client device 32, which second software component 36 comprises a representation of an Aspect Category 43 and an Aspect Type 44. The information in the first and second software component is used to request for a representation of an Aspect System Object that corresponds to the Aspect which is requested by the web client application 31. The control system 10 supports a download of the representation of the Aspect System Object 39b. The downloaded Aspect System Object 51 is initialized in the client device 32.

Figure 4 shows a more detailed representation of the first software component 34 and the second software component 36. Figure 4 shows that after down-loading the first 34 and the second 36 software component to the

client device, the client device comprise software capable of performing a table look-up to find a reference to the Aspect System Object that implements the function. The table look-up is initiated by the web client application 31, which calls a method of an interface of the Aspect Object 38. An example of name the method of the interface is QueryAspectInterface. In one embodiment an interface type is passed as a parameter to the Aspect Object 38. The interface type is denoted as a .NET interface type (.NET is a Trademark of Microsoft Inc.). This in contrast to a table-look up according to prior art, which typically involved an interface type denoted as a COM interface identifier (IID). It should be noted that compared with figure 2, figure 4 shows that the first and second component are down-loaded to the client device, and may exist anywhere on any client device in an Intranet or Internet. This in contrast to prior art as indicated by figure 2, where an Aspect Object and Aspect Type reside within the Control System. In one embodiment of the invention the first software component 34 is down-loaded before the second software component 36. In another embodiment the second software component 36 is down-loaded before the first software component 34. The software component may also be divided into several packages or messages. As an example the representation of the Aspect Object of the first software component may be sent in a package other than one or several Aspects 42.

Figure 5 shows schematically a system based on the invention. The system enables a web client application 31 to use a table look-up 53 local to the client device 32, which is a more efficient approach when it comes to use resources of the Control System 10 compared to a system

according to prior art. A user of the web client application 31 may through a user interface of the client device 32 query an Aspect of the Aspect Object 52 by a reference of an interface of the Aspect System Object 51. A reference of an interface of the Aspect System Object 39 is received 54 by the web client application 31. The Aspect System Object 51 handles the calls to a corresponding Aspect System 39 in the Control System 10, which implements the function. The Aspect System Object 51 previously initialized in the client device 32 provides access to the functions implemented by the Aspect System 39 in the Control System 10. Communication between the Aspect System Object 51 and the Aspect System 39 is for example implemented as web services defined in Hyperscript Markup Language (HTML).

CLAIMS

1. A method to enable access to a function of a real world object (11) represented as an Aspect Object (38) in a Control System (10), which comprises an Aspect System (39),
characterized in that the method comprises the steps of:
- calling a Control System (10) for an Aspect of the Aspect Object (38), through Internet or an Intranet (30), from a web client application (31) in a client device (32) external to the Control System (10),
- downloading from the Control System (10) to the client device (32) a representation of the Aspect Object (38) and Aspects associated with the Aspect Object (38),
- downloading from the Control System (10) to the client device (32) a representation of an Aspect Category (43) and an Aspect Type (44) and
- downloading a representation of an Aspect System Object (39b) to the client device (32) hosting the web client application wherein a function of the real world object is enabled for access.

2. A method according to claim 1 **characterized** in that the web client application is a web browser.

3. A method according to claim 2 **characterized** in that the calling step comprise the additional step of passing an interface type as a parameter.

4. A method according to any previous claim **characterized** in that the method comprises an additional steps of:

- initializing the Aspect Object (52) in the client device and
- initializing the Aspect System Object (51) in the client device.

5. A method according to any previous claim **characterized** in that downloading step of the first 34 and second 36 software component to the client device (32) is handled by a web server (33).

6. A method according to any previous claim **characterized** in that the step of downloading an Aspect System Object (51) comprises the additional step of:
- matching the previous mentioned interface type with an interface type listed in the Aspect Category (43) and the Aspect Type (44).

7. A method according to any previous claim **characterized** in that the function of the real world object (11) is a start, stop, open or close function.

8. A method according to any previous claim **characterized** in that the client device (32) is a personal computer, a mobile phone, a handheld device or a Personal Digital Assistant (PDA).

9. A computer program comprising program instructions which when run on a computer or a processor causes said computer or processor to carry out one or more steps of a method according to claim 1.

10. A computer readable medium 37 having a program recorded thereon, where the program is capable to make a

computer perform any of the steps of the method in claim 1.

11. A Control System (10) for access of a function of a real world object (11) associated as an Aspect of an Aspect Object (38) **characterized** in that the Control System comprises

- means for handling a call to an interface of the Aspect Object (38), through Internet or an Intranet, from a web client application (31) in a client device (32) external to the Control System (10),
- means for downloading to the client device (32) a first software component (34), which first software component (34) comprises a representation of the Aspect Object (38) and an Aspect associated with the Aspect Object (38),
- means for downloading to the client device (32) a second software component (36), which second software component (36) comprises a representation of an Aspect Category (43) and an Aspect Type (44),
- means for downloading an Aspect System Object (51) to the client device (32) hosting the web client application (31) wherein a function of the real world object (11) is enabled for access.

12. A Control System according to claim 11 **characterized** in that the web client application (31) is a web browser.

13. A Control System according to claim 12 **characterized** in that Control System comprise a web server, which handles the download of the first and second software component to the client device (32).

14. A Control System according to any previous claim characterized in that the function of the real world object (11) is a start, stop, open or close function.

15. A Control System according to any previous claim characterized in that the client device (32) is a personal computer, a mobile phone, a handheld device or a Personal Digital Assistant (PDA).

ABSTRACT

A look-up function and query capability of Aspects associated with Aspect Objects is enabled in a client device. A web client application such as a web browser executes in the client device. The Aspects are associated with functions of real world objects such as pumps, motors, mixing units, compressors, conveyors, transformers or switchgears. The client device does not need to be pre-loaded with any specific software relating to a Control System other than the web browser.

Fig. 3

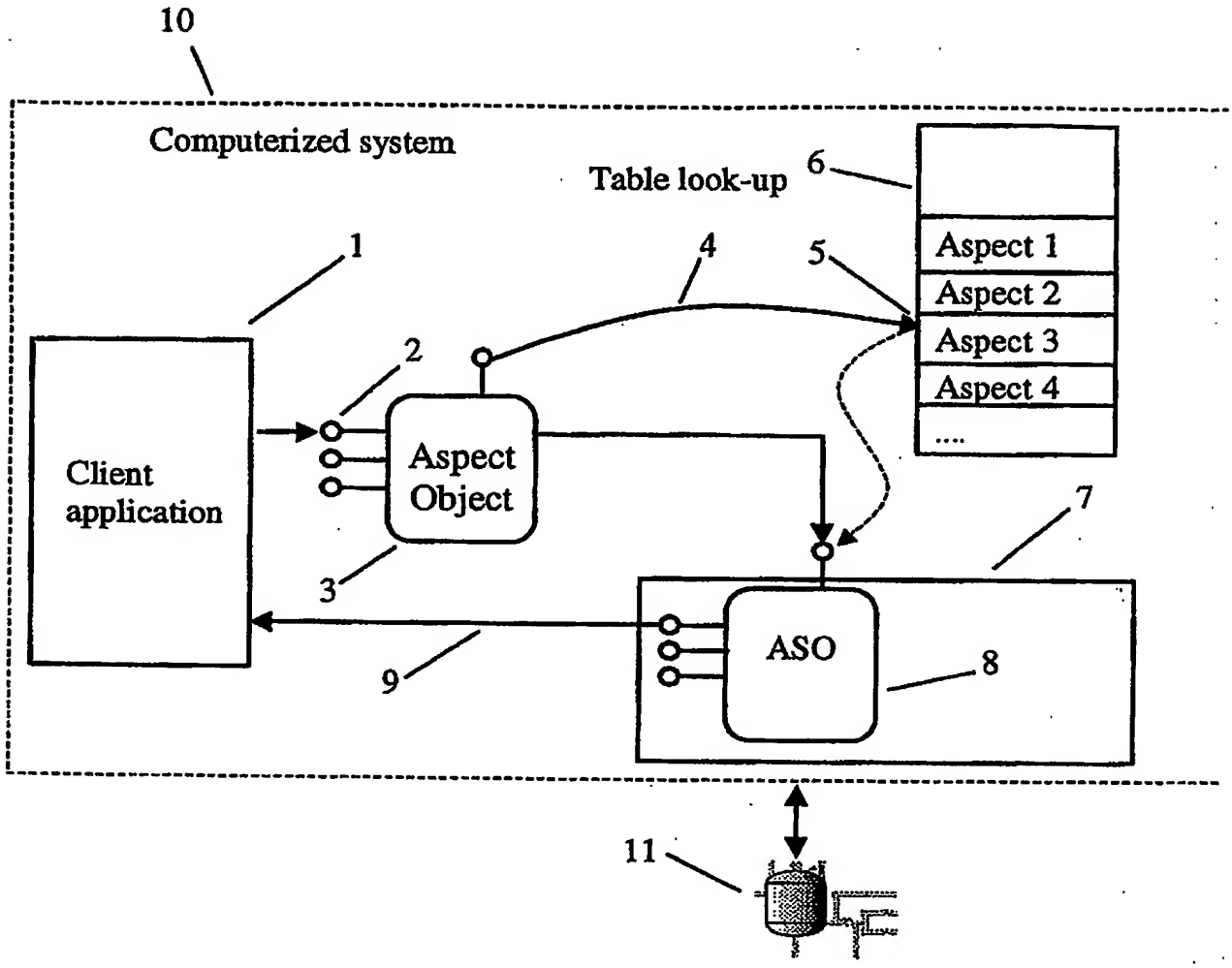

Fig. 1 (prior art)

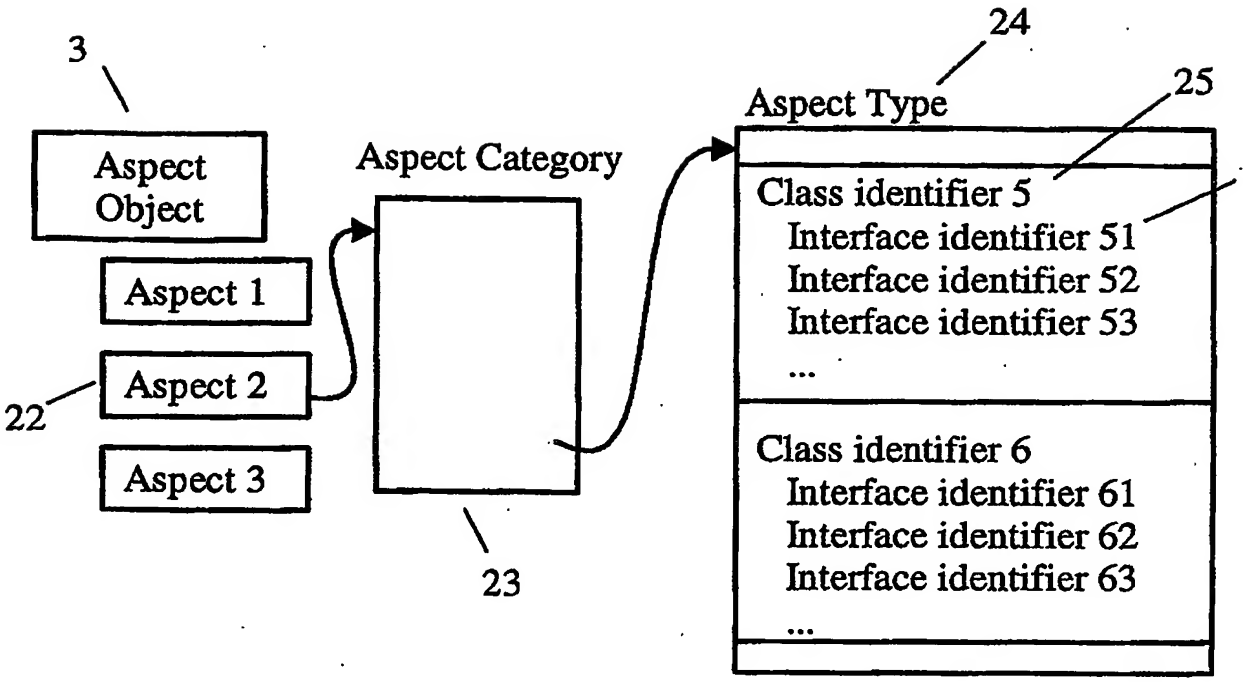

Fig. 2 (prior art)

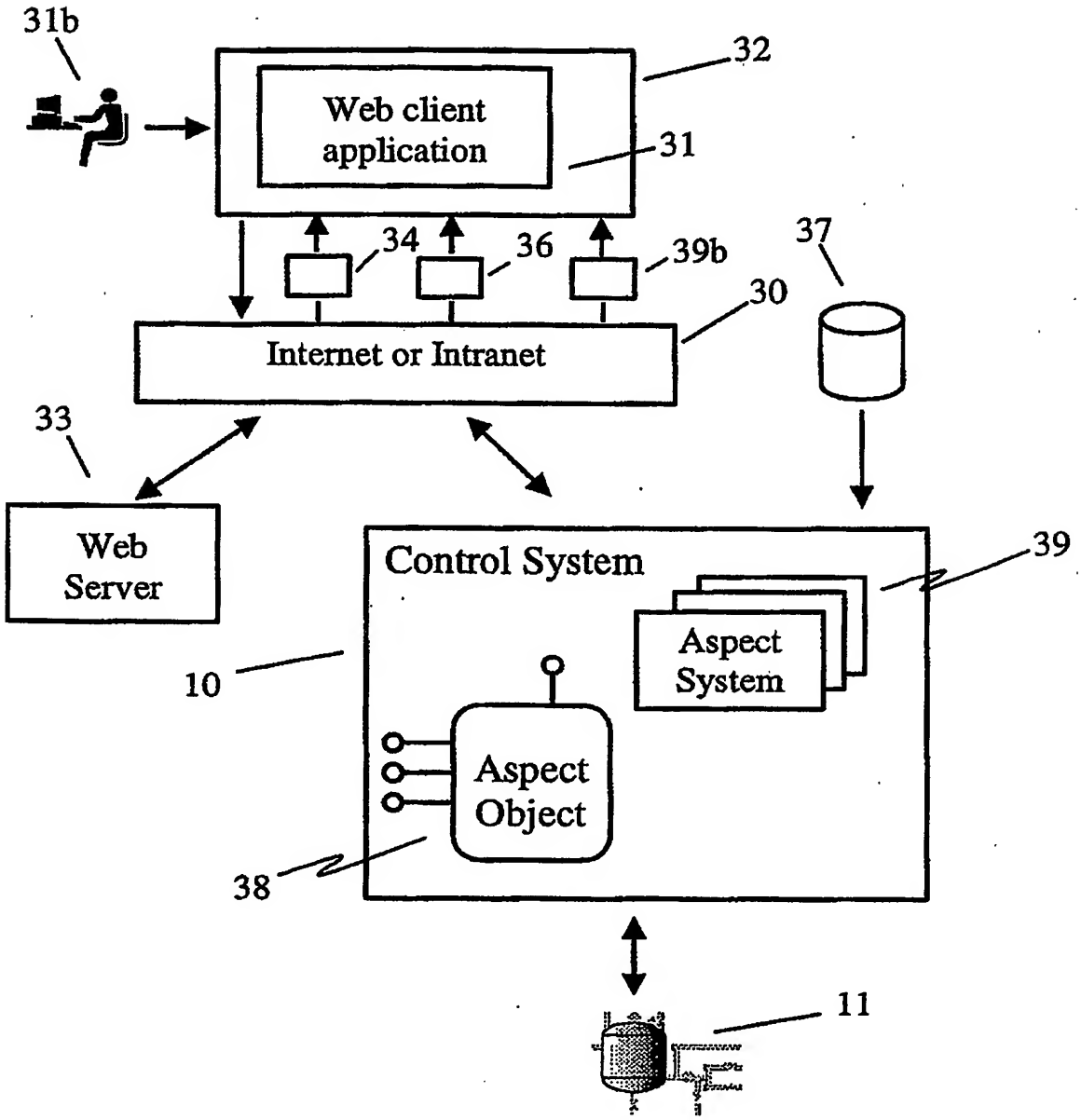
31b
32
Web client application
31
34
36
39b
37
30
Internet or Intranet
33
Web Server
Control System
39
Aspect System
10
Aspect Object
38
11

Fig. 3

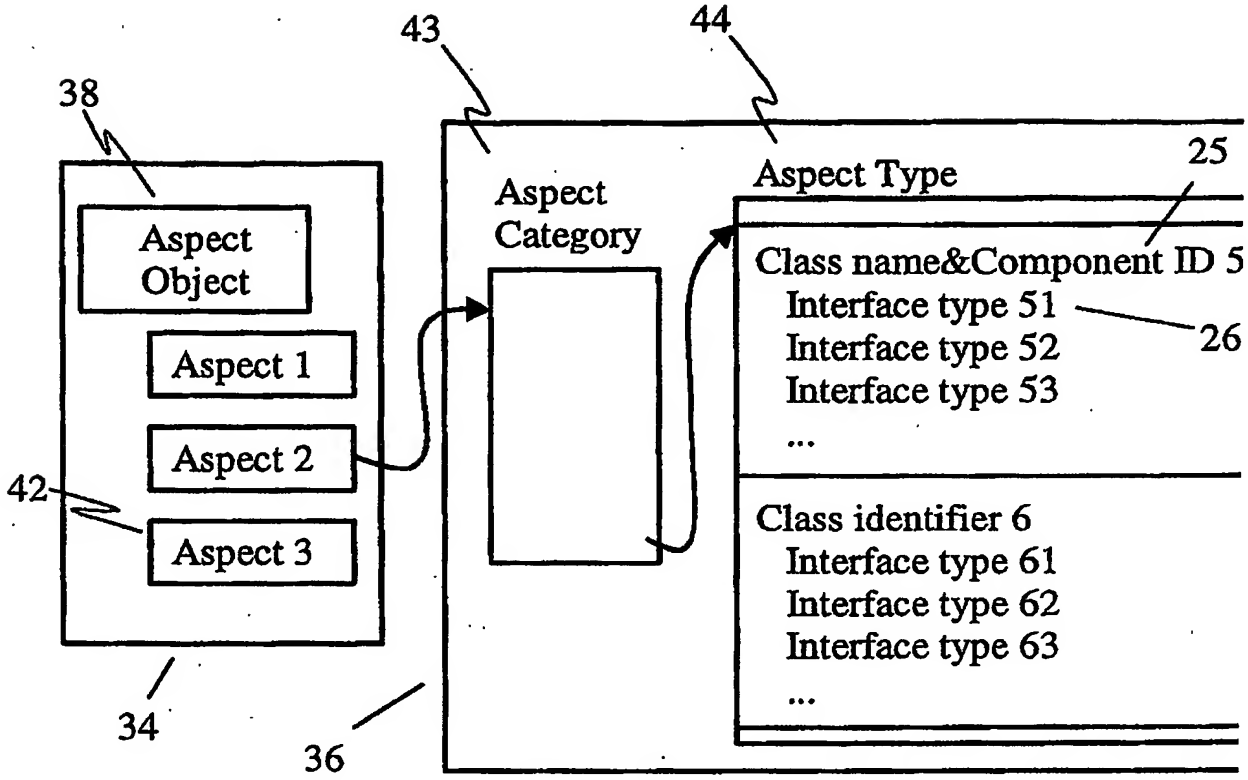
43
44
38
Aspect Type
25
Aspect Object
Aspect Category
Class name&Component ID 5
Interface type 51
26
Interface type 52
Interface type 53
...
Aspect 1
Aspect 2
42
Aspect 3
Class identifier 6
Interface type 61
Interface type 62
Interface type 63
...
34
36

Fig. 4

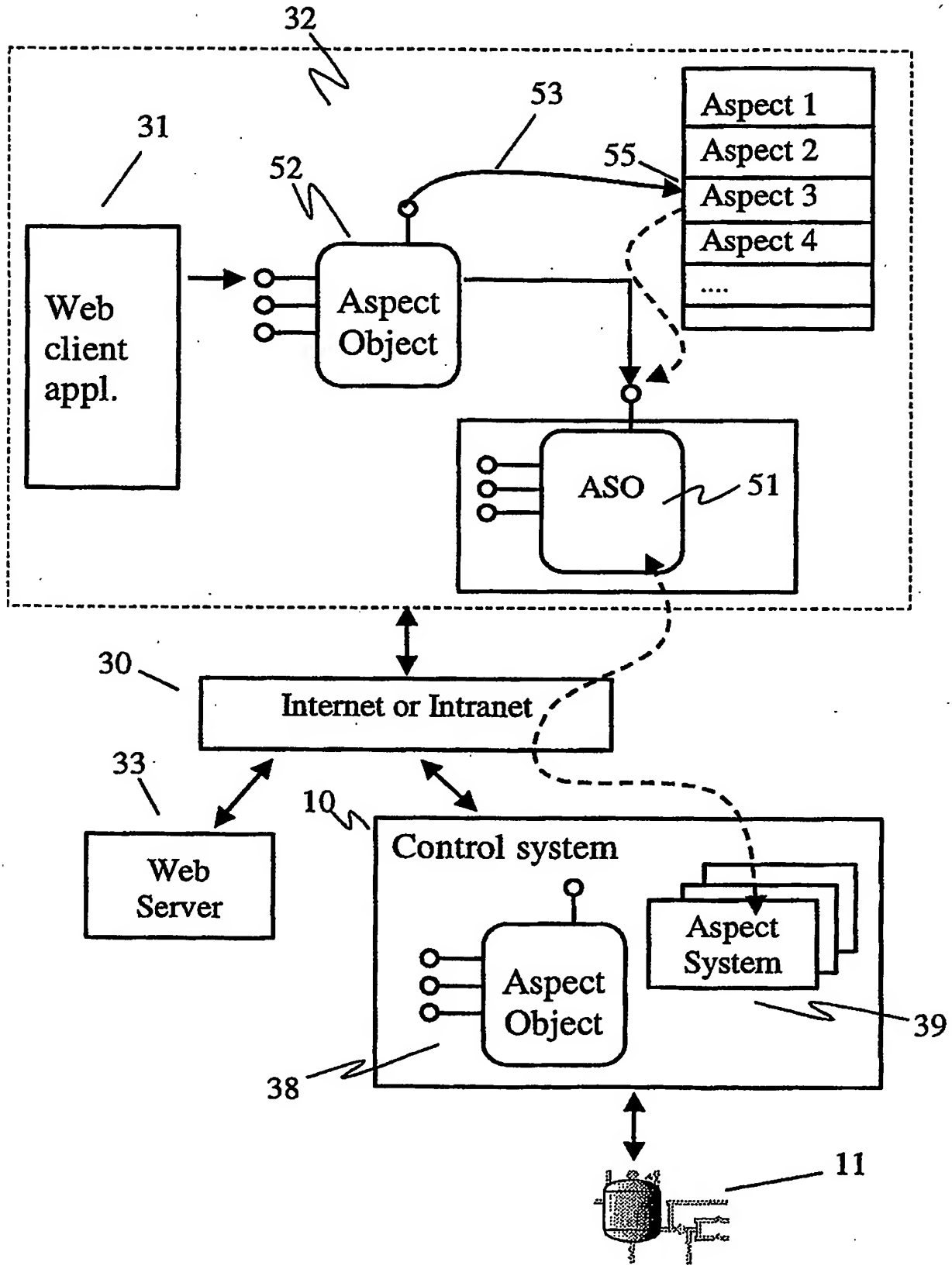
32
31
53
52
55
Aspect 1
Aspect 2
Aspect 3
Aspect 4
....
Web client appl.
Aspect Object
ASO
51
30
Internet or Intranet
33
10
Control system
Web Server
Aspect System
Aspect Object
39
38
11

Fig. 5